Impact of Huanglongbing on Citrus Tree Plantings and Removals and Welfare Implications

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Introduction
Huanglongbing (HLB), also known as citrus greening, is a devastating bacterial disease of citrus spread by the Asian citrus psyllid. The disease can cause mottled leaves, increased fruit drop, undersized fruit, and bitter or off-flavor juice, so that the fruit is unsuitable for selling. HLB is also considered the most serious disease of citrus (Gottwald, da Graça, and Bassanezi 2007). The disease was first detected in Florida in 2005 and since then has spread rapidly. It currently can be found in all counties in Florida and causes severe economic losses. Managing the HLB disease is expensive. Eradicating infected trees, which has been one of the approaches to combat the disease, is costly, too. The presence of HLB impacts the new tree planting in two ways. On one hand it increases new plantings as a replacement for the removed infected trees is needed. On the other hand it impacts the willingness of grower to invest in new plantings by discouraging them from expansion (Spreen, Baldwin, and Futch 2014). The magnitude of the citrus supply response is unclear as there are scant studies on it.

Objectives
To fill the gap in the literature, this paper analyzes the effect of HLB on new tree plantings and removals and estimates the associated economic impacts.

Methods and Data
Planting of perennial citrus trees differs from annual crops in three aspects: (i) a long period between initial planting and first sellable production, (ii) an extended period of production following the initial investment decision, and (iii) progressive deterioration of the productive capacity of trees (French and Matthews 1971). As a result, the economic analysis needs to capture these time lags. Following the literature (Laajimì et al. 2008, Devadoss and Luckstead 2010), we develop models that incorporate the HLB effect as follows:

\[ N_t = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 \pi_{t-1} + \alpha_3 R_{t-1} + \alpha_4 \pi_{t-1} + \alpha_5 HLB + \mu_0 + \nu_0 \]

\[ R_t = b_0 + b_1 \pi_t + b_2 \pi_{t-1} + b_3 HLB + b_4 hurricane + \mu_t \]

Here \( N_t \), \( R_t \) and \( B_t \) are, respectively, new plantations, removals, and bearing areas at year \( t \); \( \pi \) is the average bearing area over the last 5 years; \( \pi_{t-1} \) and \( \pi_{t-2} \) are expected long-run and short-run profits in year \( t \), respectively; \( HLB \) is a dummy variable indicating the existence of HLB at year \( t \); hurricane indicates the occurrence of hurricane at year \( t \); and finally, \( \mu_t \) denotes the error terms.

In addition to the impact of HLB on the supply response, the change in economic welfare is also estimated. HLB not only increases production costs, but also reduces fruit yield and tree numbers. The supply curve shifts in a parallel manner plus a slope change (i.e., shift and pivot) as a result of HLB.

Results and Discussion
The tree planting and removal model are estimated simultaneously using ITSUR, and the welfare analysis is conducted using an equilibrium displacement model in a partial equilibrium context.

The results show that HLB statistically significantly reduced new plantings and increased tree removals, consequently reduced citrus production. The welfare analysis indicate that HLB has caused significant economic loss.

Conclusions
The adverse effect of HLB on citrus industry is profound. The results from this study can assist decision makers in the citrus industry and government to better understand the economic importance of finding solutions to citrus HLB.

Selected Reference